



April 1998

## LM123/LM323A/LM323 3-Amp, 5-Volt Positive Regulator

### General Description

The LM123 is a three-terminal positive regulator with a pre-set 5V output and a load driving capability of 3 amps. New circuit design and processing techniques are used to provide the high output current without sacrificing the regulation characteristics of lower current devices.

The LM323A offers improved precision over the standard LM323. Parameters with tightened specifications include output voltage tolerance, line regulation, and load regulation. The 3 amp regulator is virtually blowout proof. Current limiting, power limiting, and thermal shutdown provide the same high level of reliability obtained with these techniques in the LM109 1 amp regulator.

No external components are required for operation of the LM123. If the device is more than 4 inches from the filter capacitor, however, a 1  $\mu$ F solid tantalum capacitor should be used on the input. A 0.1  $\mu$ F or larger capacitor may be used on the output to reduce load transient spikes created by fast switching digital logic, or to swamp out stray load capacitance.

An overall worst case specification for the combined effects of input voltage, load currents, ambient temperature, and power dissipation ensure that the LM123 will perform satisfactorily as a system element.

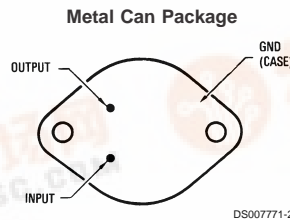
For applications requiring other voltages, see LM150 series adjustable regulator data sheet.

Operation is guaranteed over the junction temperature range  $-55^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  for LM123,  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  for LM323A, and  $0^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  for LM323. A hermetic TO-3 package is used for high reliability and low thermal resistance.

### Features

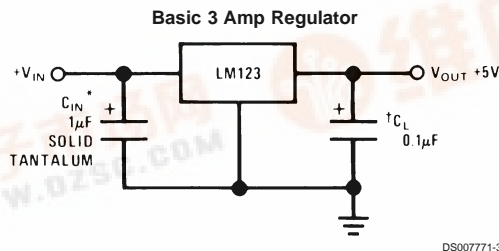
- Guaranteed 1% initial accuracy (A version)
- 3 amp output current
- Internal current and thermal limiting
- 0.01 $\Omega$  typical output impedance
- 7.5V minimum input voltage
- 30W power dissipation
- P+ Product Enhancement tested

### Connection Diagram



Order Number LM123K STEEL, LM323AK STEEL or LM323K STEEL  
See NS Package Number K02A  
Order Number LM123K/883  
See NS Package Number K02C

### Typical Applications



\*Required if LM123 is more than 4" from filter capacitor.  
†Regulator is stable with no load capacitor into resistive loads.

LM123/LM323A/LM323 3-Amp, 5-Volt Positive Regulator



### Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

(Note 5)

Input Voltage 20V  
Power Dissipation Internally Limited

### Operating Junction Temperature Range

LM123 -55°C to +150°C  
LM323A -40°C to +125°C  
LM323 0°C to +125°C

Storage Temperature Range -65°C to +150°C

Lead Temperature (Soldering, 10 sec.) 300°C

ESD Tolerance (Note 5) 2000V

### LM123 Electrical Characteristics (Note 2)

Parameter	Conditions	LM123			Units
		Min	Typ	Max	
Output Voltage	$T_j = 25^\circ\text{C}$ $V_{IN} = 7.5\text{V}, I_{OUT} = 0\text{A}$	4.7	5	5.3	V
	$7.5\text{V} \leq V_{IN} \leq 15\text{V}$ $0\text{A} \leq I_{OUT} \leq 3\text{A}, P \leq 30\text{W}$	4.6		5.4	V
Line Regulation (Note 4)	$T_j = 25^\circ\text{C}$ $7.5\text{V} \leq V_{IN} \leq 15\text{V}$		5	25	mV
Load Regulation (Note 4)	$T_j = 25^\circ\text{C}, V_{IN} = 7.5\text{V},$ $0\text{A} \leq I_{OUT} \leq 3\text{A}$		25	100	mV
Quiescent Current	$7.5\text{V} \leq V_{IN} \leq 15\text{V},$ $0\text{A} \leq I_{OUT} \leq 3\text{A}$		12	20	mA
Output Noise Voltage	$T_j = 25^\circ\text{C}$ $10\text{ Hz} \leq f \leq 100\text{ kHz}$		40		$\mu\text{Vrms}$
Short Circuit Current Limit	$T_j = 25^\circ\text{C}$ $V_{IN} = 15\text{V}$ $V_{IN} = 7.5\text{V}$		3	4.5	A
			4	5	A
Long Term Stability				35	mV
Thermal Resistance Junction to Case (Note 3)			2		$^\circ\text{C/W}$

### LM323A/LM323 Electrical Characteristics (Note 2)

Parameter	Conditions	LM323A			LM323			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage	$T_j = 25^\circ\text{C}$ $V_{IN} = 7.5\text{V}, I_{OUT} = 0\text{A}$	4.95	5	5.05	4.8	5	5.2	V
	$7.5\text{V} \leq V_{IN} \leq 15\text{V}$ $0\text{A} \leq I_{OUT} \leq 3\text{A}, P \leq 30\text{W}$	4.85		5.15	4.75		5.25	V
Line Regulation (Note 4)	$T_j = 25^\circ\text{C}$ $7.5\text{V} \leq V_{IN} \leq 15\text{V}$		5	10		5	25	mV
Load Regulation (Note 4)	$T_j = 25^\circ\text{C}, V_{IN} = 7.5\text{V},$ $0\text{A} \leq I_{OUT} \leq 3\text{A}$		25	50		25	100	mV
Quiescent Current	$7.5\text{V} \leq V_{IN} \leq 15\text{V},$ $0\text{A} \leq I_{OUT} \leq 3\text{A}$		12	20		12	20	mA
Output Noise Voltage	$T_j = 25^\circ\text{C}$ $10\text{ Hz} \leq f \leq 100\text{ kHz}$		40			40		$\mu\text{Vrms}$
Short Circuit Current Limit	$T_j = 25^\circ\text{C}$ $V_{IN} = 15\text{V}$ $V_{IN} = 7.5\text{V}$		3	4.5		3	4.5	A
			4	6		4	5	A
Long Term Stability				35			35	mV
Thermal Resistance Junction to Case (Note 3)			2			2		$^\circ\text{C/W}$

## LM323A/LM323 Electrical Characteristics (Note 2) (Continued)

**Note 1:** "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

**Note 2:** Unless otherwise noted, specifications apply for  $-55^{\circ}\text{C} \leq T_j \leq +150^{\circ}\text{C}$  for the LM123,  $-40^{\circ}\text{C} \leq T_j \leq +125^{\circ}\text{C}$  for the LM323A, and  $0^{\circ}\text{C} \leq T_j \leq +125^{\circ}\text{C}$  for the LM323. Although power dissipation is internally limited, specifications apply only for  $P \leq 30\text{W}$ .

**Note 3:** Without a heat sink, the thermal resistance of the TO-3 package is about  $35^{\circ}\text{C/W}$ . With a heat sink, the effective thermal resistance can only approach the specified values of  $2^{\circ}\text{C/W}$ , depending on the efficiency of the heat sink.

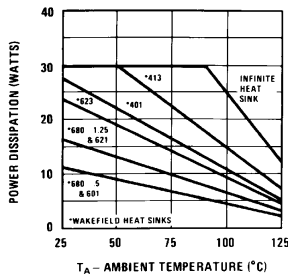
**Note 4:** Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width  $\leq 1\text{ ms}$  and a duty cycle  $\leq 5\%$ .

**Note 5:** Refer to RETS123K drawing for LM123K military specifications.

**Note 6:** Human body model,  $1.5\text{ k}\Omega$  in series with  $100\text{ pF}$ .

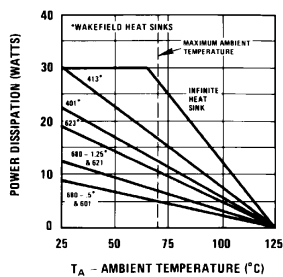
## Typical Performance Characteristics

**Maximum Average Power Dissipation for LM123**



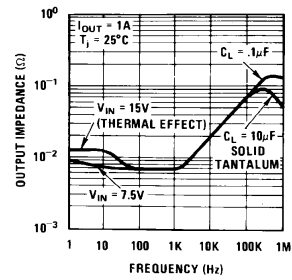
DS007771-9

**Maximum Average Power Dissipation for LM323A, LM323**



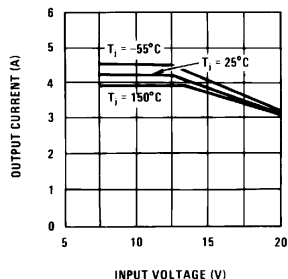
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**Output Impedance**



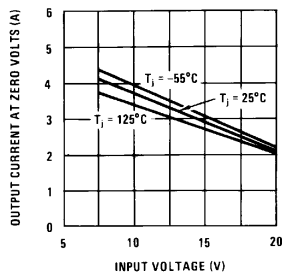
DS007771-11

**Peak Available Output Current**



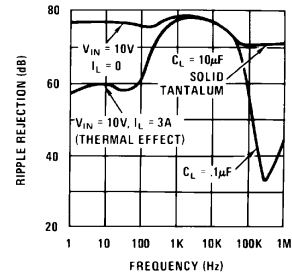
DS007771-12

**Short Circuit Current**



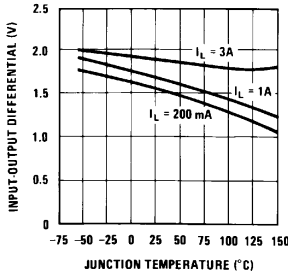
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**Ripple Rejection**



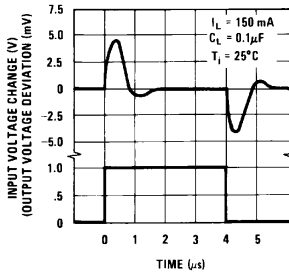
DS007771-14

**Dropout Voltage**



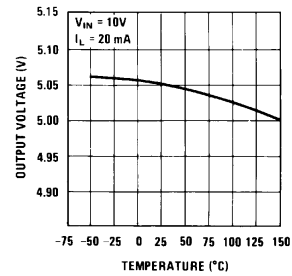
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**Line Transient Response**



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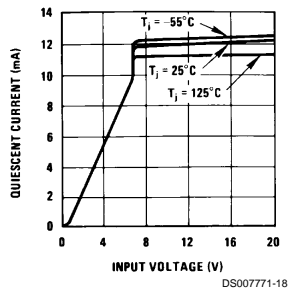
**Output Voltage**



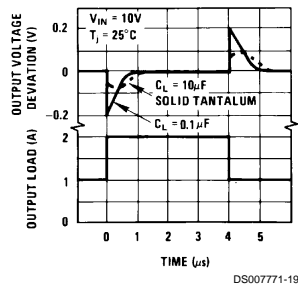
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## Typical Performance Characteristics (Continued)

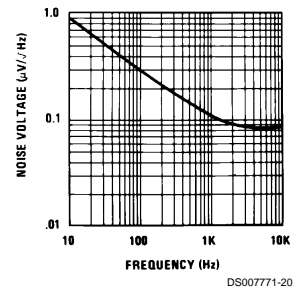
Quiescent Current



Load Transient Response

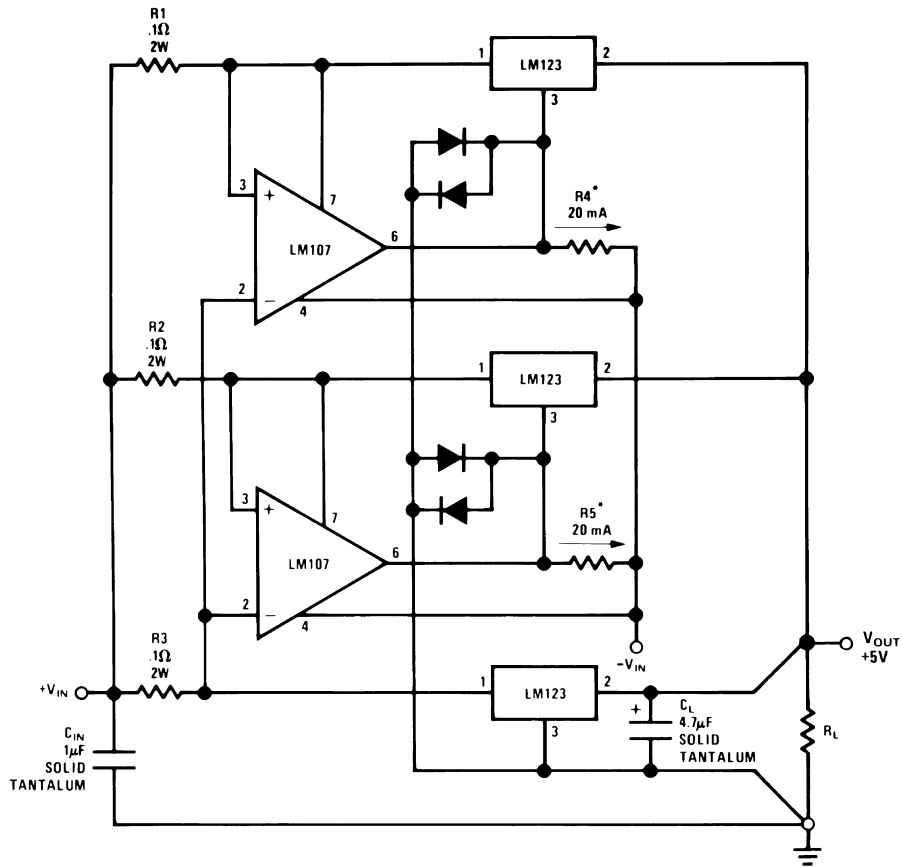


Output Noise Voltage



## Typical Applications

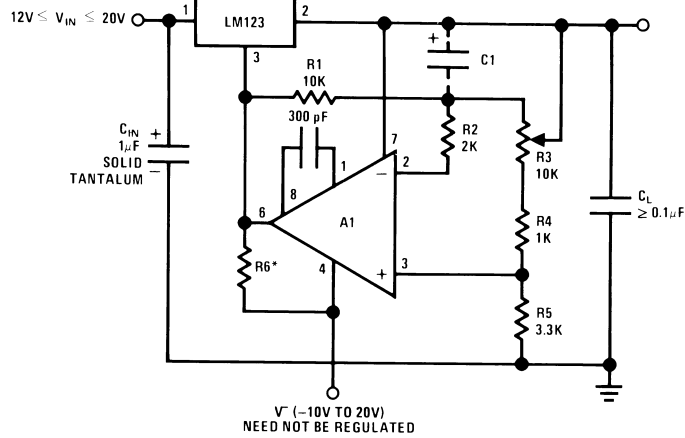
10 Amp Regulator with Complete Overload Protection



\*Select for 20 mA Current from Unregulated Negative Supply

## Typical Applications (Continued)

### Adjustable Regulator 0V–10V @ 3A



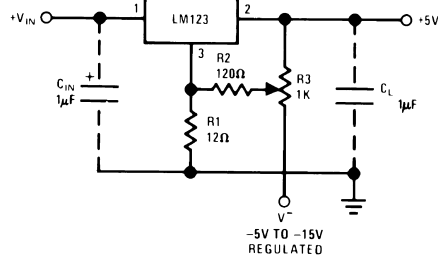
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$$*R6 = \frac{V^-}{12 \text{ mA}}$$

A<sub>1</sub> — LM101A

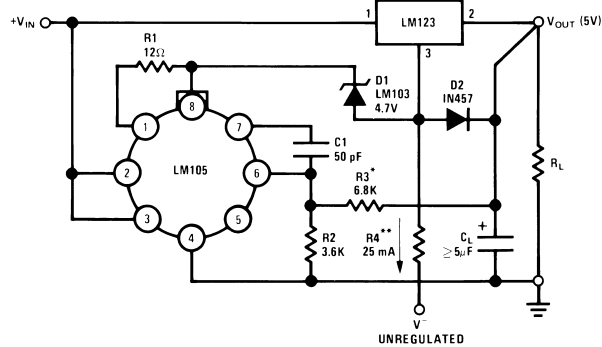
C<sub>1</sub> — 2 μF Optional — Improves Ripple Rejection, Noise, and Transient Response

### Trimming Output to 5V



DS007771-8

### Adjustable Output 5V–10V 0.1% Regulation

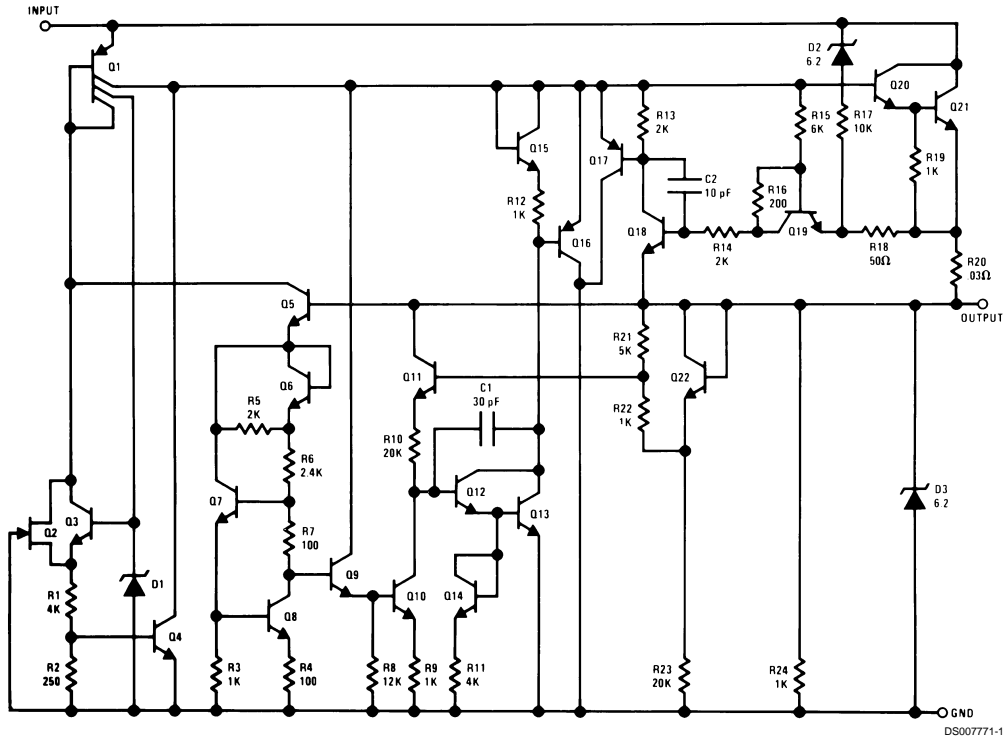


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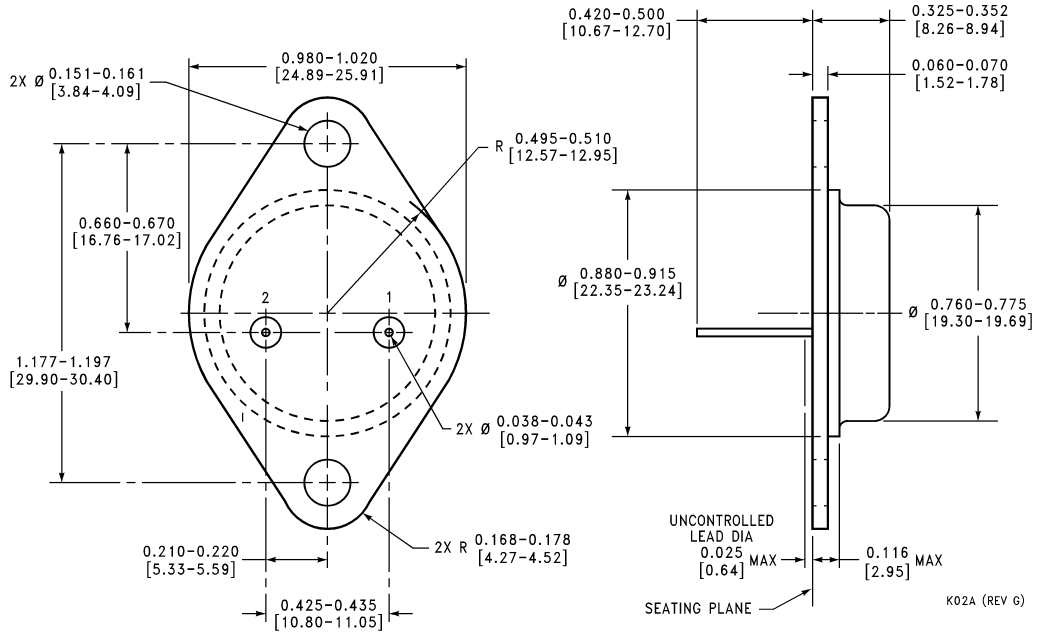
\*Select to Set Output Voltage

\*\*Select to Draw 25 mA from V<sup>-</sup>

# Schematic Diagram



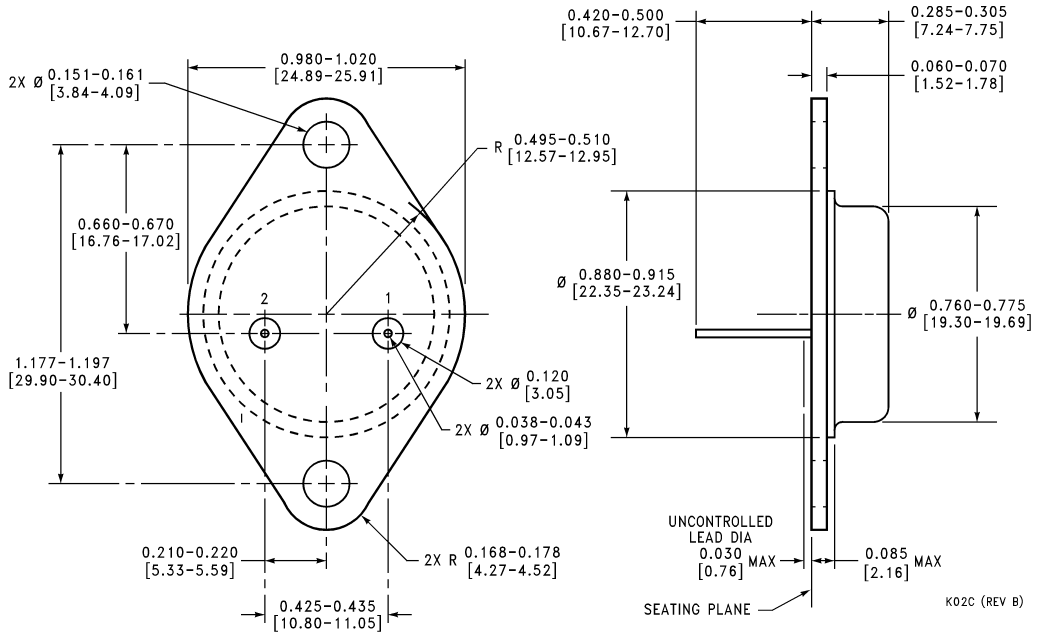
**Physical Dimensions** inches (millimeters) unless otherwise noted



**Metal Can Package (K)**  
**Order Number LM123K STEEL, LM323AK STEEL or LM323K STEEL**  
**NS Package Number K02A**

K02A (REV 6)

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**Metal Can Package (K)**  
**Mil-Aero Product**  
**Order Number LM123K/883**  
**NS Package Number K02C**

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